The 4th Workshop of COST Action IC0902
Cognitive Radio and Networking for Cooperative Coexistence of Heterogeneous Wireless Networks
October 9–11, 2013
Rome, Italy

AUTHORS CONSENT TO INCLUDE THIS CONTRIBUTION IN THE OPEN ACCESS ONLINE REPOSITORY OF IC0902: YES
NAME OF AUTHOR GIVING CONSENT:
Liljana Gavrilovska

“Contribution to Working Group/Special Interest Group <SIG4: Positioning>”

Joint Localization Algorithms for Network Topology Ambiguity Reduction

M. Angjelicinoski, D. Denkovski, V. Atanasovski, L. Gavrilovska

L. Gavrilovska

The transmitter localization and its application in contemporary wireless systems are extensively covered research topics. The Received Signal Strength (RSS)-based source localization algorithms are of particular interest lately due to their satisfactory precision and implementational simplicity, which stems from the presence of RSS extraction feature in every wireless device. The generic network setup for RSS-based source localization (Fig. 1) comprises set of measuring network nodes i.e. sensors (referred as anchors) distributed over a specific geographical area. The anchors measure the receiving power of the signal broadcasted by the source (agent) with unknown position. The existing localization algorithms require the anchors’ positions to be precisely known in advance [1]. The information is usually obtained in some previous estimation procedure (e.g. using GPS) preceding the localization process. However, in many cases, the estimation procedure is coarse and provides erroneous and insufficiently precise estimates which results in network topology ambiguity. Furthermore, the imprecision in the anchor positions estimates propagates in the transmitter localization process causing higher source position estimation errors.

This work analyzes the impact of erroneous anchor position information on the source localization algorithm performance and introduces novel RSS-based joint localization framework. The framework consists of set of algorithms that jointly estimate the source’s and the anchors’ positions. Thus, the joint localization algorithms are capable of reducing the initial network topology ambiguity due to previous anchor position estimation, whilst providing more reliable source localization performance. In order to illustrate the promising localization and network topology calibration potentials of the framework, the Joint Maximum

Likelihood (JML) localization algorithm is developed and evaluated as a proof-of-concept. The work invokes the classical, non-Bayesian estimation formalism for the development of the joint localization framework [2].

The JML is compared with the classical Maximum Likelihood (ML) termed as the Legacy ML (LML), which assumes the incorrect anchor position to be precise. Both algorithms are evaluated in a specific simulation scenario that adopts the simplified path loss model in log-normal shadowing (σ in dB) and assumes that the anchor position estimates are distributed according to circular Gaussian distribution with variance Δ in meters. The JML and the LML are compared in terms of the Root Mean Squared Error (RMSE) for different σ and Δ, Fig. 2. As evident, the JML results in high source localization gain especially for large Δ, which suggest that the proposed joint localization framework is very suitable for network topology calibration in scenarios with large initial uncertainties.

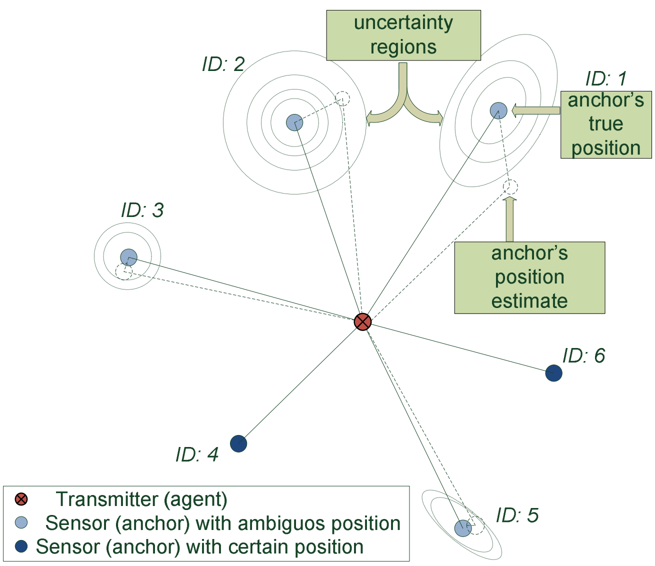

Figure 1. General system model

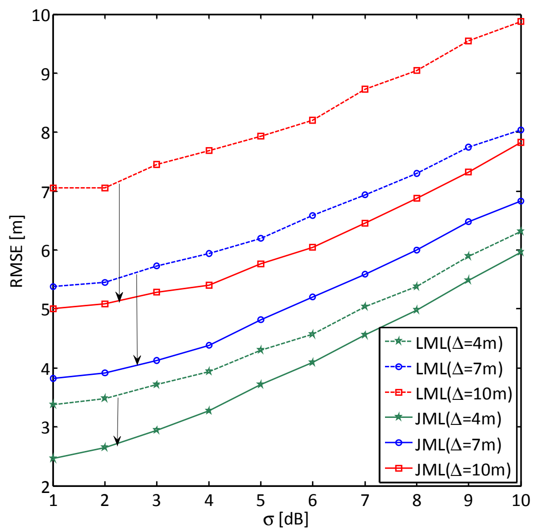

Figure 2. JML vs. LML

References

[1] Yuan Shen and M. Z. Win, "Fundamental Limits of Wideband Localization – Part I: A General Framework," IEEE Transactions on Information Theory 56(10), pp. 4956-4980, October 2010.

[2] S. M. Kay, *Fundamentals of Statistical Signal Processing: Estimation Theory*, Prentice-Hall, 1998.